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DEVELOPING A TRACKING-EDIBLE GEL/TOXICANT DELIVERY SYSTEM FOR CONTROL OF RATTUS NORVEGICUS AND MUS MUSCULUS

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ABSTRACT

A potentially useful technique for the control of rodent pests is to incorporate rodenticides into gel-substance which could contaminate the fur. Contaminated rodents would then ingest the toxicant during grooming. The grooming acceptance of petroleum jelly and molasses formulas was tested. Simple devices also were developed and tested as means to contaminate rats and mice.

INTRODUCTION

Most rodents groom foreign substances contaminating their fur. One approach to rodent control is to contaminate rodents which then ingest a toxicant during grooming (Sanchez, 1977; Poche et al., 1979; and Fellows, 1980). This approach is useful in situations where rodents do not readily consume bait because of abundance of alternative food, or bait shyness.

The objectives of this study were to (1) develop tracking gels, petroleum jelly and a molasses formulation, for testing as possible gel contaminants, and (2) develop simple devices for presenting the gel contaminants to Rattus norvegicus and Mus musculus in cage experiments and in simulated field studies, and measuring the amounts removed in each case.

Techniques for applying a toxic gel to the fur of rodents so that they ingest the poison while grooming themselves are still developmental. Early lab and field trials were done in the Philippines and Bangladesh (Sanchez, 1977; Fiedler, 1979; Poche et al., 1979; and Fiedler, 1980 and 1983). Automotive grease/zinc phosphide and used motor oil/zinc phosphide formulations were applied to banana leaves and to tiles and put along the runways of Rattus r. mindanensis in rice paddies in the Philippines (Fiedler, 1979, 1980, and 1983). Poche et al. (1979) applied zinc phosphide/grease formulations to the bamboo sticks in the entrances of the burrows of the leser bandicoot rat, Bandicota bengalensis in Bangladesh, but the results were not encouraging.

The development, use, and evaluation of a brodifacoum containing wick device for the control of commensal house mice was done by

This piece of work has been carried out in the laboratories of Denver Wildlife Research Center, Denver, CO 80225, U.S.A.

Morris et al. (1983). Reidinger, Jr. (1985) invented a method and apparatus for automatically dispensing a measured amount of a rodent control liquid on to the dorsal fur of rodents.

In the present work, attempts were carried out in two parallel lines: first, to develop a suitable gel substance using available and inexpensive ingredients, and secondly, to design simple and safe devices for dispensing the gel/toxicant material.

MATERIALS AND TECHNIQUES

Development of a molasses gel formulation :

Attempts were made to develop a molasses gel which met the following requirements for use in developing countries:

1. Locally available and inexpensive ingredients.
2. Tacky for about 30 days.
3. Having an appropriate viscosity.
4. Not having repellent qualities.

Molasses was mixed with wheat flour, vegetable oil, margarine, and glycerin in various ratios to test for these requirements. The formulation was prepared by mixing the wheat flour thoroughly with the molasses. The mixture was heated on a hot plate with continuous stirring for 30 minutes to reduce the water content of molasses, resulting in 6% weight loss of the mixture (high temperature must be avoided). Margarine was then added and mixed with molasses and wheat flour until the mixture is homogeneous. Glycerine was finally added and mixed to the cold formulation. These ingredients provide the following properties:

1. Commercial molasses is viscous and sticky, especially if heated for some time to reduce its water content.
2. Wheat flour was added to thicken the formulation.
3. Glycerine increases the tack over a longer time, however, it can also decrease viscosity, making the formulation drip from the plastic tubes described below.
4. Margarine is solid and improves the gel nature of the formulation.

Measuring the amounts of gel removed by caged animals :

This cage study was conducted on individually caged Wistar rats and Swiss Webester mice. The test animals were maintained on Purina Laboratory Chow # 5001 and water ad libitum.

A device was developed to measure gel removed, which consisted of a plastic tube (10 cm long and 2 cm in diameter) rotating freely on an axis of steel wire (11.5 cm long and 0.3 cm in diameter). The wire axis was on the lower side of a square wire frame that holds the tube device in the animal cage (Fig. 1-A). Two additional plastic tubes which rotated on the two vertical sides of the wire frame were used in some devices (Fig. 1-B). The dimensions of the device used for caged mice were 5.5 cm long with a 2 cm outer diameter for the plastic tube, and 6.5 cm long and 0.3 cm in diameter for the wire axis. The sides of the wire frame were 14 cm long (Fig. 1-C).

Cages used in the case of rats were 33 cm x 17.5 cm x 17.5 cm, and those of mice were 24 cm x 17.5 cm x 17.5 cm. The lower surfaces of the plastic tubes hung approximately 4 cm (rats) and 1.5 cm (mice) above the cage floor.

A known amount of each tracking gel was applied evenly to the outer surface of the plastic tube and the whole device was weighed to the nearest 0.1 g, using Mettler PE 3600 scale, and a device was suspended in each cage. After 24 h the devices were removed from the cages and weighed to the nearest 0.1 g. One device with a known amount of the candidate gel was put in an empty cage under the same laboratory conditions to determine weight loss or gain from ambient humidity to correct for the amount of gel consumed.

A gel station for simulated field study :

Simple tubes or cans were used for applying molasses gel (gel stations) to wild rats and mice. For mice, soft drink cans were used for this purpose. These cans are readily available, very inexpensive, and their preparation as gel stations was very easy. Two holes, each measuring 2 cm in diameter, were one on each end of the can and at two different levels (Fig. 2). The molasses gel was spread on the lower half of the interior surface of the cans through the holes using a spatula, and

the cans were set in the mice room. Rats were provided with cardboard boxes (20 cm x 8 cm x 8 cm)with both ends open to test readiness of rats to pass through these potential gel stations. Powdered rice mixed with Dayglo AY 13 Rocket Red flourescent dye was spread on the interior flooor of boxes to detect any rat movements inside. Plastic tubes (20 cm long and 9 cm diameter) were then used for presenting molasses gel to rats. The gel was spread around the lower interior surface of the tubes.

In this simulated field test, wild rats and mice were established in separate rooms. Each room was approximately 5 m x 4 m with a tight door, and it was illuminated only during animal care and data collections. Individual rats and mice were weighed to the nearest 0.1 g just before release into the rooms. Sixteen large cardboard boxes (60 cmx 30 cm x 30 cm), each with a 5 cm hole at one of the lower corners, and furnished with bedding for harborage and nesting, were set in the rat room. Boxes were set along the walls of the room with the holes directed to the center of the room. Thirty small cardboard boxes (9 cm x 9 cm x 9 cm) were similarly prepared and put in the mice room. Each room was provided with water, a heater, and a thermometer. Two large wheat bags (about 22.5 kg) were put on a wooden pailet, about 10 cm off the floor at the center of each room. A bottle filled with drinking water was put in each room.

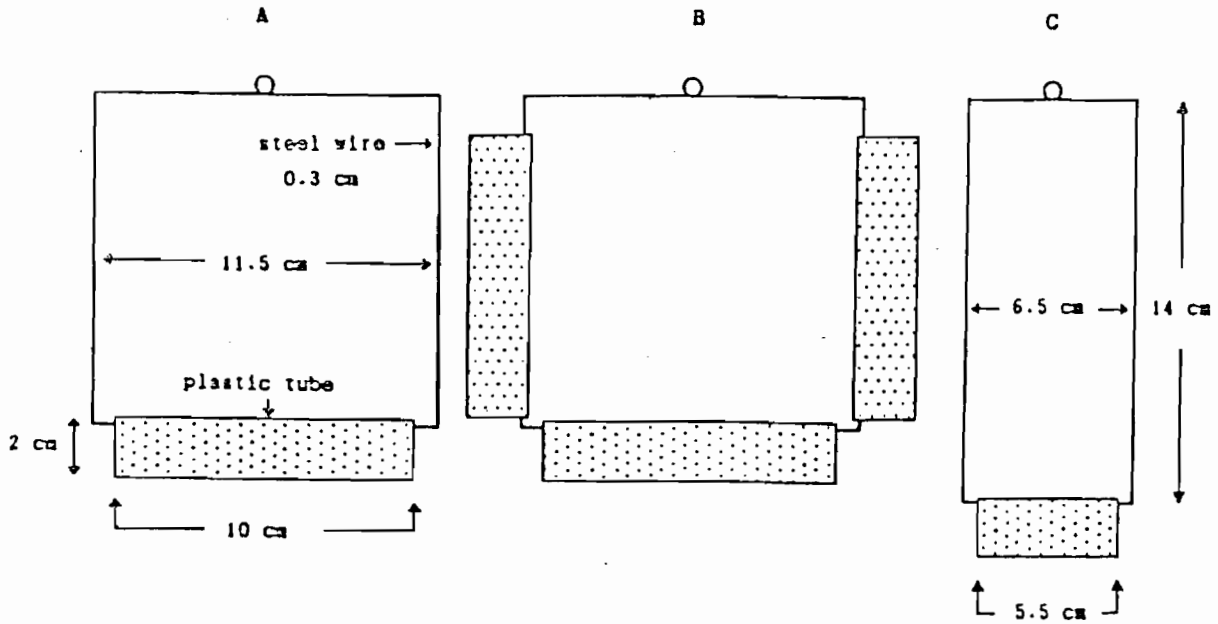

Fig. 1. A DEVICE FOR MEASURING THE GEL REMOVED BY CAGED RATS AND MICE

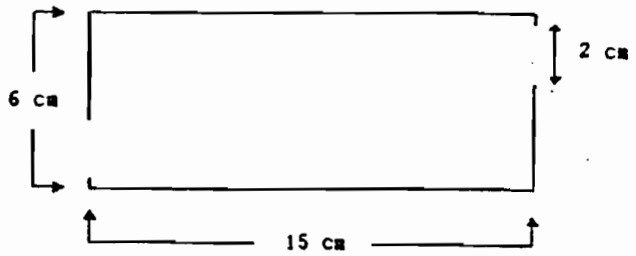

Fig. 2. A GEL STATION FOR SIMULATED FIELD STUDIES ON MICE

When possible, 3 males and 10 females of wild Norway rats, and 5 males and 15 females of wild house mice were acclimated for two-weeks in each room. During this period the stability of the population was observed and dead individuals were replaced by others of the same sex. After this two-week period, plain molasses gel was provided for three nights. The average amounts removed by individual rodents were calculated. Molasses gel/toxicant formulations were applied to ten plastic tubes and ten cans, and each was then weighed to the neareest 0.1 g. The tubes and cans were evenly distributed in the rat and mouse rooms respectively around the wall and the wooden pailet in the center of the room. The tubes and cans were left for 3-5 days after which they were removed, weighed, and the amount of the gel/toxicant removed was determined.

Table 1. Mean daily consumption of plain molasses gel and of low and high concentrations of toxicant/molasses gel formulation by individual albino rats and mice.

			Plain gel (g/indiv.)		Zinc phosphide/gel (g/indiv.)				Brodifacoum/gel (g/indiv.)			
					Low *		High*		Low*		High*	
	Strain	No.	M	F	M	F	M	F	M	F	M	F
Albino rats	Wistar	10	1.6+	1.6+	1.3	1.2	1.1	0.9	2.9	2.9	1.7	1.8
Albino mice	Swiss Webester	10	0.9+	1.1+	0.8	0.8	0.7	0.7	1.5	1.7	2.3	2.4

* The low and high concentrations of zinc phosphide in case of rats are : 22,44 mg/g gel (M) and 17.5, 35 mg/g gel (F) and in case of mice : 8.3, 9.3 mg/ g. (M) and 5.9, 7.3 mg/g (F). The low and high concentrations of brodifacoum in case of rats are : 0.070, 0.085 mg/g (M) and 0.070, 0.075 mg/g (F) and in case of mice : 0.030, 0.045 mg/g (M) and 0.030, 0.030 mg/g (F).

+ This step was repeated several times. The figures pesented herein are the minimum averages obtained.

Table 2. Mean daily removal of petroleum jelly by individual albino rats and mice.

	Strain	No.	Petroleum jelly (g/indiv.)	
			M	F
Albino rats	Wistar	10	0.5	0.6
Albino mice	Swiss Webester	10	0.3	0.2

Table 3. Average amounts of plain molasses gel and molasses gel/toxicant removed from individual gel stations by wild rats and mice over different time periods.

	Strain	No. animals	No. gel stations	Plain gel (3days) (g/station)	Zinc phosphide/ gel (7days) (g/station)	Brodifacoum/ gel(5days) (g/station)
Rattus norvegicus	Wild	13	10	25.7*	1.9	2.4
Mus musculus	Wild	20	10	9.9	1.2	5.1

* This step was repeated several times with different groups of rats which showed a much lesser attitude to remove plain molasses gel.

RESULTS

Molasses gel evaluation :
The most satisfactory formulation was a 45 : 15 : 15 : 25 ratio of molasses, wheat flour, margarine, and glycerine, respectively.

Plain molasses gel was readily accepted by caged albino rats and mice. When mixed with zinc phosphide (up to 44 mg/g gel for albino rats and 9.3 mg/g gel for albino mice), the gel was also accepted (Table 1).

Wild rats and mice also accepted the gel when mixed with zinc phosphide (up to 8.7 mg/g and 7.5 mg/g gel for rats and mice,respectively), and brodifacoum (up to 0.066 mg/g and 0.035 mg/g for rats and mice,respectively).

Petroleum jelly evaluation :
The amounts of petroleum jelly removed by test animals were less than that of molasses gel (Table 2).

Simulated field study :
Mice readily entered the cans and removed the molasses gel. Rats readily moved inside the cardboard boxes as indicated by feet and tail tracks. The average amounts of plain molasses gel, zinc phosphide/gel, and brodifacoum/gel formulations removed by rats and mice over given periods of time are presented in table 3. The amounts removed are expressed in terms of grams gel formulations per tube (gel station).

DISCUSSION

Cage studies as well as simulate field studies indicated that both albino and wild rodents readily removed molasses gel both by contact and by direct ingestion. Differences between rats and mice were found. In cage tests, albino mice removed gel or gel/toxicant formulations more readily than albino rats. In simulated field studies, wild rats preferred wheat grains over than molasses gel. Wild mice, however, readily removed molasses gel in the presence of wheat grains. Soft drink cans proved to be good for dispensing gel/toxicnat formulations to mice. The use of cans as gel stations seems to be of a good applied value, especially in situations where children and non-target animals are exposed to the poisoning effects of control chemicals. Cans keep the gel/toxicant formulations away from the reach of children and non-target animals, thus reducing to a great extent, the hazards of environmental pollution. Such gel stations are useful in controlling mice in grain stores, villages, fields, and in urban areas, especially in developing countries. Moreover, the ingredients of the molasses gel are available and inexpensive, and

the method of preparation is very easy. Cans are also available and inexpensive.

Tubes and pipes were also used in the Philippines to deliver a contact toxicant to Rattus r. mindanensis (Sanchez, 1977). In this study rats did not consistently use the plastic tubes. The use of tubes as gel stations for rat control needs more studies to develop the technique.

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أسلوب مبتكر لمكافحة الفار النرويجى وفأر المنزل الصغير باستخدام الجيلاتين السام كمادة غذائية وعالقة

للدكتور / سهيل سليمان
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من المشاكل الهامة فى مكافحة القوارض بعد تناولها كمية غير قاتلة من الطعوم السامة ، نفورها من هذه الطعوم . وقد وجد أن أحد الوسائل البديلة للمقاومة هى الاعتماد على سلوك هذه القوارض فى تنظيف فرائها من المواد العالقة به عن طريق لعقها بالفم ، وبالتالى فان خلط السموم بمواد تعلق بفراء هذه الآفات تجعلها تجد طريقها بسهولة الى جهازها الهضمى عند تنظيف فرائها .

وفى هذه الدراسة تم أختبار كفاءة مادتين جيلاتينيتين هما الجيلاتين البترولى وجيلاتين العسل الاسود كمادتين تصلحان للتعلق بفراء القوارض ، وتم ايضا ابتكار أجهزة بسيطة لتقديم هذه المواد الجيلاتينية للقوارض سواء فى التجارب المعملية على حيوانات الأقفاص أو فى تلك التجارب التى أجريت تحت ظروف شبه طبيعية . وقد أثبتت التجارب المعملية كفاءة جيلاتين العسل الأسود ، وهى مادة تتكون من خليط العسل الأسود ودقيق القمح والسمن النباتى والجلسرين ، كمادة يتقبلها كل من الفأر النرويجى وفأر المنزل الصغير حتى بعد خلطها بالسموم . كما أثبتت الأجهزة البسيطة المبتكرة كفاءة عالية فى استخدامها . وتجدر الاشارة هنا الى أن الفئران النرويجى قد أظهرت عدم استجابة لجيلاتين العسل الأسود عند تجربته تحت الظروف شبه الطبيعية ، مما يتطلب مزيدا من الدراسات على استخدامه فى مكافحة هذه الفئران . (١٠ / ٨٨)

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